Space Weather Technical Forecast

Issued on Wednesday, 23 November 2022 at 01:28 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: Slight Chance of R1/R2 radio blackouts throughout. Slight chance of Minor Geomagnetic Storm (G1) intervals by the end of the period.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low in the past 24 hours, with the largest X-ray flare of the period an isolated C7.0 flare at 22/0727 UTC. This flare emanated from AR3151, now Beta-Gamma/Dai, which have been developing through the past 24 hours and continues to grow in complexity. The two other regions on the visible disk, AR3147 Beta/Cho and AR3149 Beta/Dso are both stable. A new area is emerging from the northeast limb with signs of development but at this stage remains plage.

Fairly weak CME emanating from the C7.0 flare at 22/0727 UTC near centre disk is currently forecast to give the potential for minor impacts with an arrival time perhaps at the end of the current forecast period. We await further imagery around the potential for a further CME associated with the C-class flare from 22/1910 UTC, also from near centre disk.

Solar Wind / Geomagnetic Activity: The solar wind have slowly eased through the period to background levels around 320km/s with the phi angle accordingly mostly negative (towards the Sun) throughout. Density has been mostly average. The IMF was weak below 8 nT. The north-south component was erratic but generally weak between +3/-2 nT. Quiet geomagnetic activity, (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) as measured at GOES16 has remained at Background levels.

High energy electron flux (greater than 2MeV) at GOES16 was at Normal Background levels throughout. Electron fluence levels remained well below Active (1e8 integrated pfu) levels. Observed fluence at 23/0001 UTC was 1.53e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to remain Low, with a slight chance of isolated M-class X-ray flares.

Solar Wind / Geomagnetic Activity: There is two CMEs currently included in the forecast. One that may glance Earth early day 1 (23rd), this is the large filament lift-off from 19 November, and a second from the C7.0 flare at 22/0727 UTC into day 4 (26th) though this low confidence.
A slow-ambient solar wind regime expected to continue through day 1 (23rd) and into day 2 (24th), given no transitory CME effects. Coronal hole CH47/+ potentially becoming geo-effective later on day 2 (24th) and into day 3 (25th), with an increase to Slight Elevated winds is possible. Confidence then lowers through day four, with CH48/+ currently expected to become geo-effective later in the day. Elevated wind speeds possible with an increased risk of Minor Storm

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

(G1/Kp5) intervals.

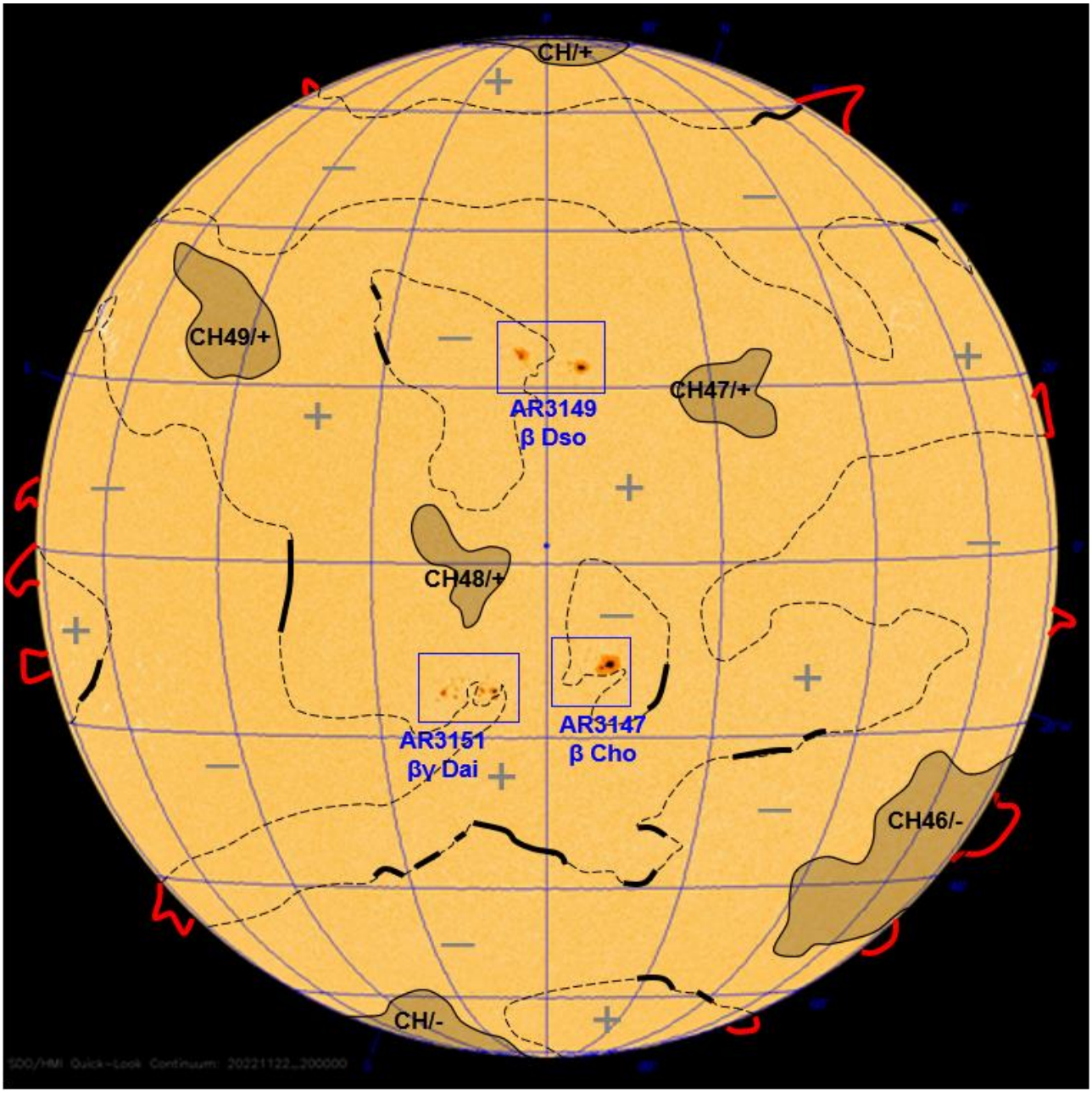
The resulting forecast is for generally Quite to Unsettled conditions days 1 to 3 (23rd-25th), with a slight chance of Active intervals. Into day 4 (26th) an increase to generally Unsettled conditions expected with occasional Active periods and a slight chance of Minor Storm (G1/Kp5) intervals.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) observed by GOES16 is expected to remain at Background levels throughout.
Electron flux is forecast to remain near currently observed levels at GOES16, meaning that 24-hour integrated fluence is expected to remain below Active throughout, albeit with reducing confidence towards day 4 (26th).

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Figure 1. Solar Analysis Valid 22/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Met Office Space Weather Technical Forecast

Geomagnetic Storms:

There is currently one main CME that features in the four-day forecast. This feature emanated from the northeastern solar hemisphere on Saturday 19 November, and may potentially graze Earth early day 1 (23rd) with a very Slight Chance of G1. Another fairly weak CME emanating from a C7 flare near centre disk early on the 22nd is currently forecast to give the potential for minor impacts with an arrival time perhaps at the very end of the current period.

A slow-ambient solar wind regime expected to continue through day 1 (23rd) and into day 2 (24th), given no transitory CME effects. Coronal hole CH47/+ potentially becoming geo-effective later on day 2 (24th) and into day 3 (25th). Although current ENLIL model runs suggest limited impact, an increase to Slight Elevated winds is possible inline with persistence. Confidence then lowers through day four, with CH48/+ currently expected to become geo-effective later in the day, with changes in its geometry between last pass and recent imagery suggesting a later arrival than that expected through 27-day persistence. Elevated wind speeds possible however with an increased risk of Minor Storm (G1/Kp5) intervals.

The resulting forecast is for generally Quite to Unsettled conditions days 1 to 3 (23rd-25th), with a slight chance of Active intervals. Into day 4 (26th) an increase to generally Unsettled conditions expected with occasional Active periods and a slight chance of Minor Storm (G1/Kp5) intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	1	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
19/1650	Partial	Filament Eruption	NE quadrant	490km/s	22/2359UTC +/- 8 hours	Low confidence, lack of CH46 fast wind will Slow transit. Glancing Blow.
22/0727	Partial	C7 flare	AR3151	256km/s	26/1200UTC +/- 12 hours	Low confidence, given interaction with CH48.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

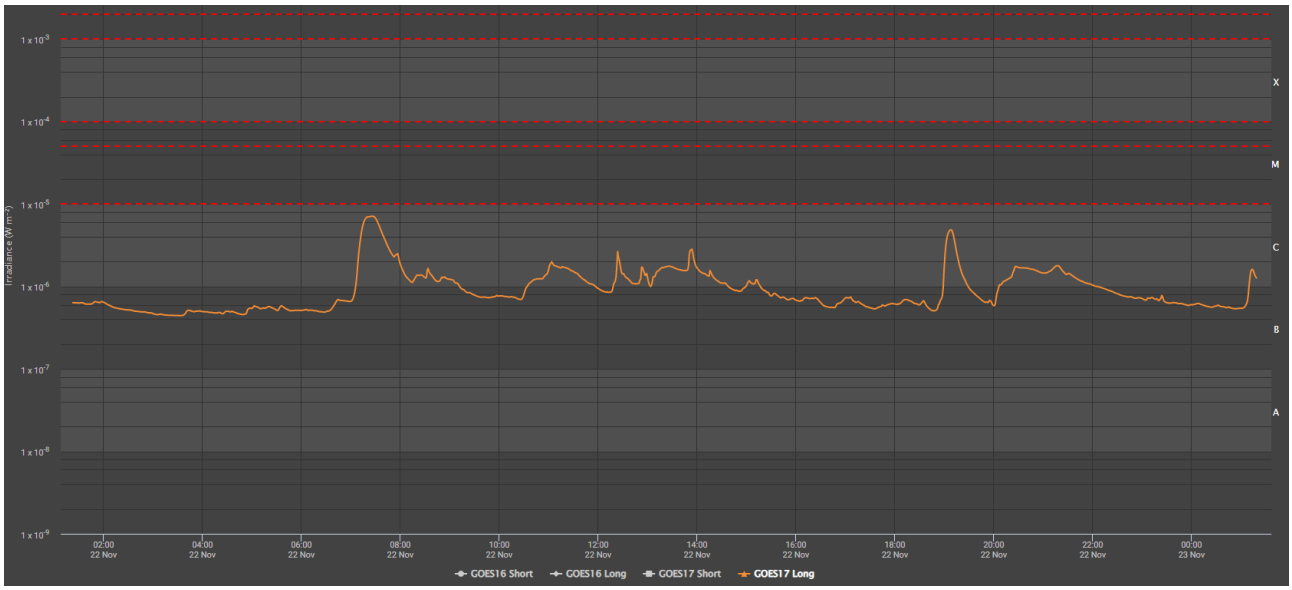
Radio Blackouts - X-Ray Flares:

Solar activity has been Low over the past 24 hours, though a C7 flare was observed at 22/0727 UTC from developing region AR3151, this region has continued to show increasing complexity and carries the current bulk of the the slight chance of an M-Class flare through the period. AR3149 in the northeastern quadrant has also responsible for some C-class activity in the past 24 hours. This region appears to be stabilised somewhat however.

There is one returning region current arriving over the northeast limb (Ex-3135) but this appears a relatively unremarkable region and is not currently classified. The next arriving region of any size from NSO GONG far-side soundings is perhaps due towards the end day 4 (26th).

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	20	20	20	20
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 2: GOES17 X-Ray flares



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (greater than 10MeV) at GEO, as observed by GOES16 is currently at background and expected to persist at this level.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

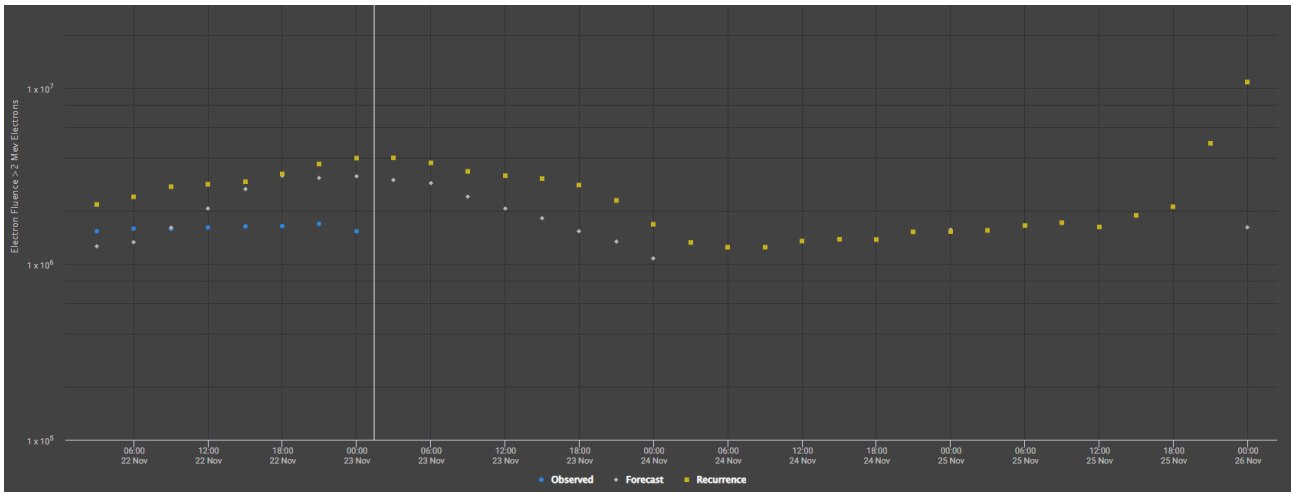
© Crown Copyright 2022. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) as observed by GOES16 has been near Normal Background levels throughout the last 24 hours. Flux is thought likely to remain at Normal Background to Moderate levels for much of the period, though more significant coronal hole activity towards the end of the period increases the risk of Moderate to High levels.

24-hour integrated electron fluence is expected to remain below the Active threshold to start the period, as on last rotation, but the risk of electron fluence towards Active levels increases as CH48/+ approaches toward the end of the four day period. Confidence remains low however given observed differences with this coronal hole compared to the last rotation.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	10	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: Latest MOSWOC REFM Model showing fluence well below 1e8 Active level.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.